Run IIb L1 CAL Infrastructure

- Trigger Signal
- Run IIa System
- Constraints
- Transition System
- Cabling
- Sidewalk
- Run IIb Racks
- Installation

Patch Panels on Sidewalk Test Stand

All photos and schematics shown in this talk and supporting documentation can be found at or linked from the following URL:

www-clued0.fnal.gov/~alstone/D0Work/L1Cal/l1cal.html

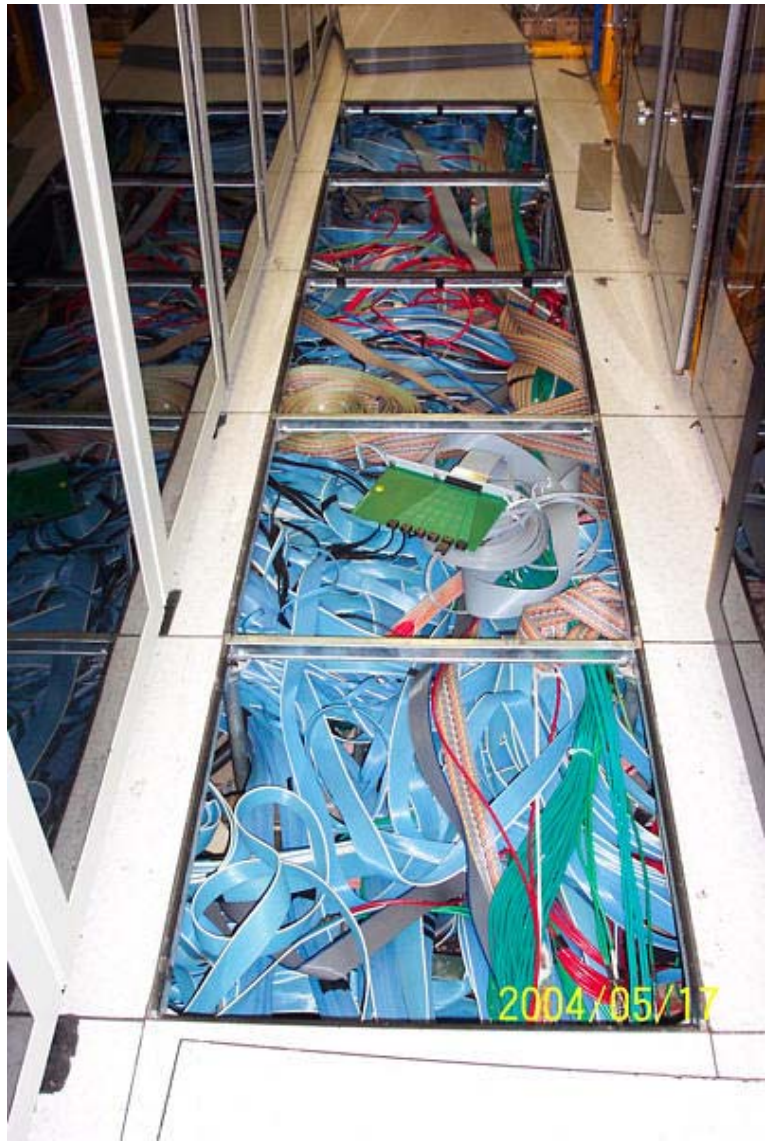
L1 CAL Trigger Signal

- The trigger pickoff of the Calorimeter signals takes place on the Baseline Subtractor (BLS) cards on the detector platform.
  - Calorimeter + ICD has 55296 total electronics channels but 7932 channels are invalid:
    - 7880 by design (Detector vs. Preamp vs. BLS mapping).
    - 46 because of broken cables between Preamp and BLS.
    - 6 non-connected ICD channels due to the helium lines for the Solenoid.
  - 1152 BLS cards each with 4 CAL Precision Towers: 2 η x 2 φ x 12 depth (EM & HAD layers).
- The signals from the physics channels for all EM and Hadronic layers are added with the appropriate weights to form the analog trigger sums and then passed through trigger summer drivers.
  - There are 2560 such drivers - one for each of the 1280 Trigger Tower (TT) EM & HAD components.
  - Note: For $|\eta|>3.6$, each BLS sends 2 TTs sums: 1152+(2)(2)(32)=1280.
- These analog sums are transported differentially to the L1 Calorimeter Trigger electronics on the first floor of the Moveable Counting House (MCH1). [See Slide 3]
  - Each TT (EM+,EM-,HD+,HD-) signal is carried along four consecutive coaxial cables to MCH1 and distributed among ten racks (M103-M112).
- The trigger eta & phi has a factor of two larger granulation than the precision readout (physics) eta & phi.
  - Note: Precision and Trigger have the same Tower eta resolution for $|\eta|>3.6$.
- Each L1 CAL trigger rack receives as inputs TT cables from all phi (1:32) for a consecutive group of eta (+1:+4, -1:4, +5:+8 … +17:+20, -17:-20).

Run IIa L1 CAL Trig Electronics

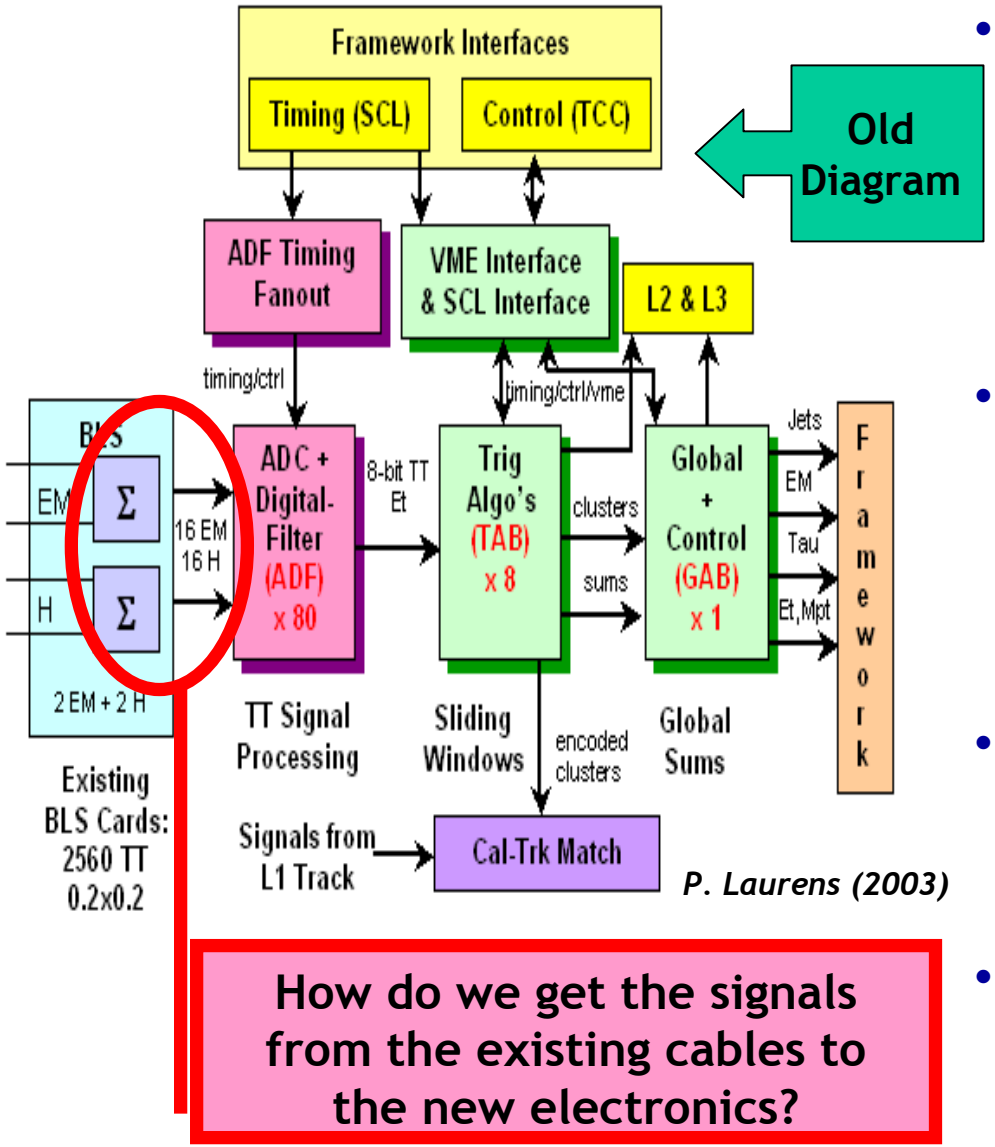
Ten racks of trigger electronics. 128 BLS trigger cables are routed to each rack.

Constraint #1: BLS Trigger Cables



- TDR - Reuse BLS trigger cables.
- 78 & 80 Ohm impedance, 130-180 ft in length.
  - Installed at the beginning of Run I.
  - No spares cables to run.
  - Cannot access cables at the CAL BLS detector platform end.
- Congested space beneath floor boards.
  - No place to store cables between decommissioning of Run IIa & installation of Run IIb.
- Too risky to try and reroute trigger cables.

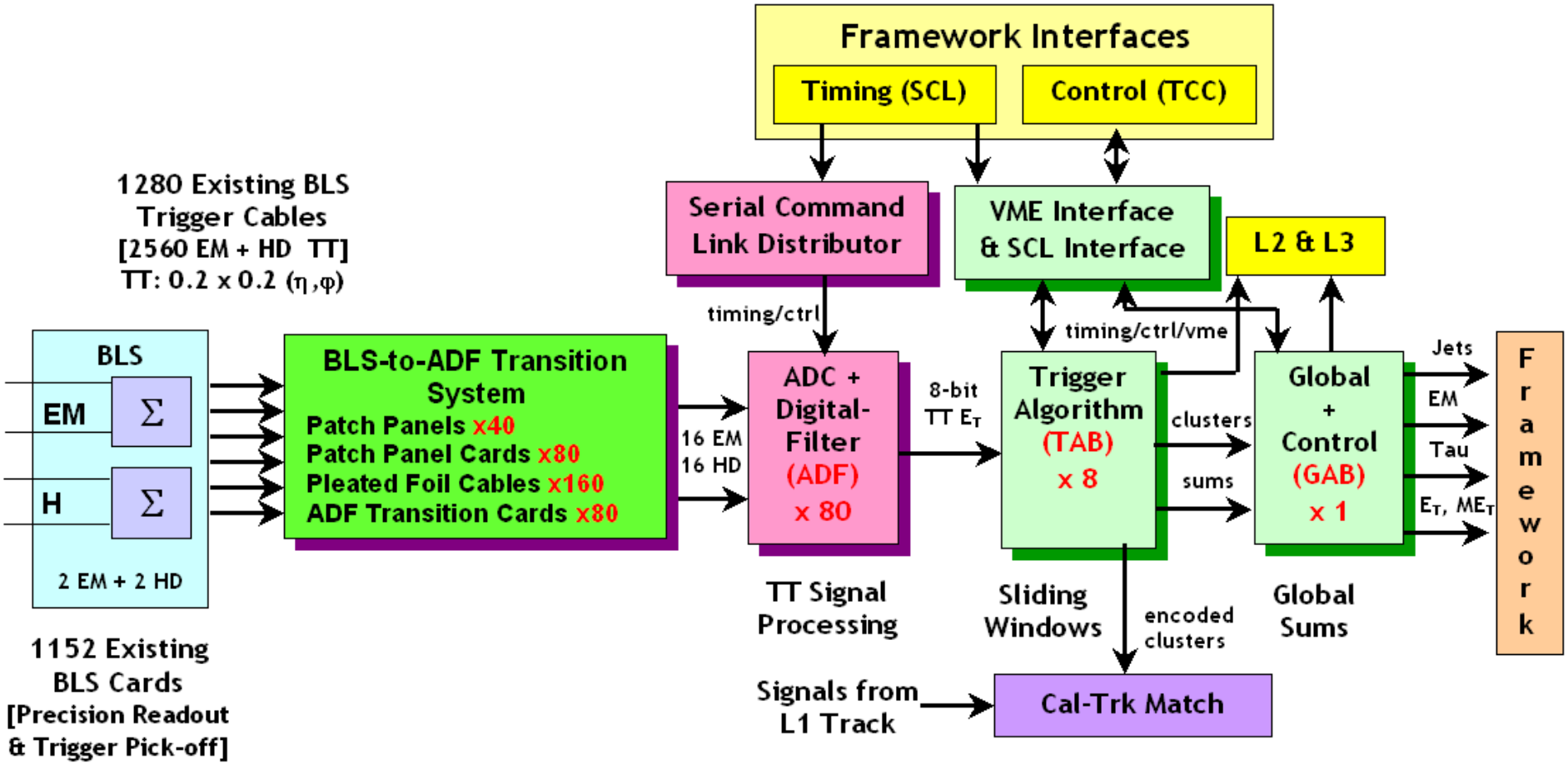
Constraint #2: New Electronics



How do we get the signals from the existing cables to the new electronics?

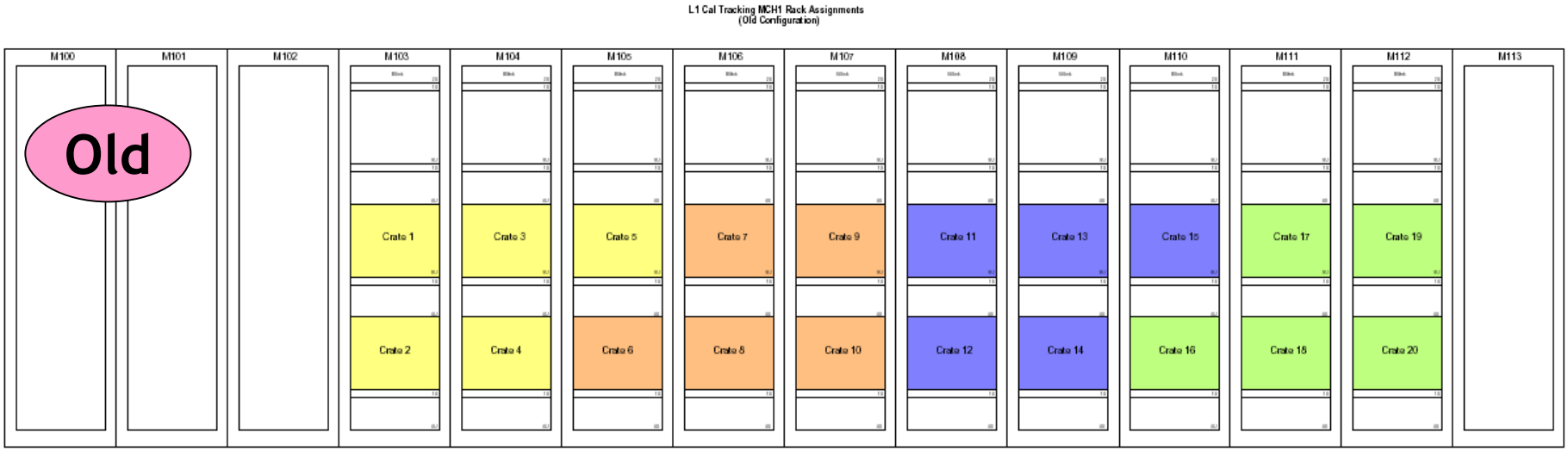
- New electronics are more compact.
  - 4 crates (new) vs 20 crates (old).
  - Cable congestion at ADF and TAB backplanes.
    - 1280 BLS, 240 LVDS cables.
  - Channel mapping, strain relief.
- ADF backplane connector mismatch.
  - Cannot plug 8-pin BLS trigger cable connectors directly into 20-pin ADF backplane connectors.
  - Cannot plug LVDS cable into ADF backplane without removing key.
- ADF-to-TAB signal flipping.
  - TAB backplane connectors assume a different orientation of signals from ADF backplane output.
- Cable access & channel debugging.
  - Plug in scope during physics data taking without disconnecting cables.

BLS-to-ADF Transition System

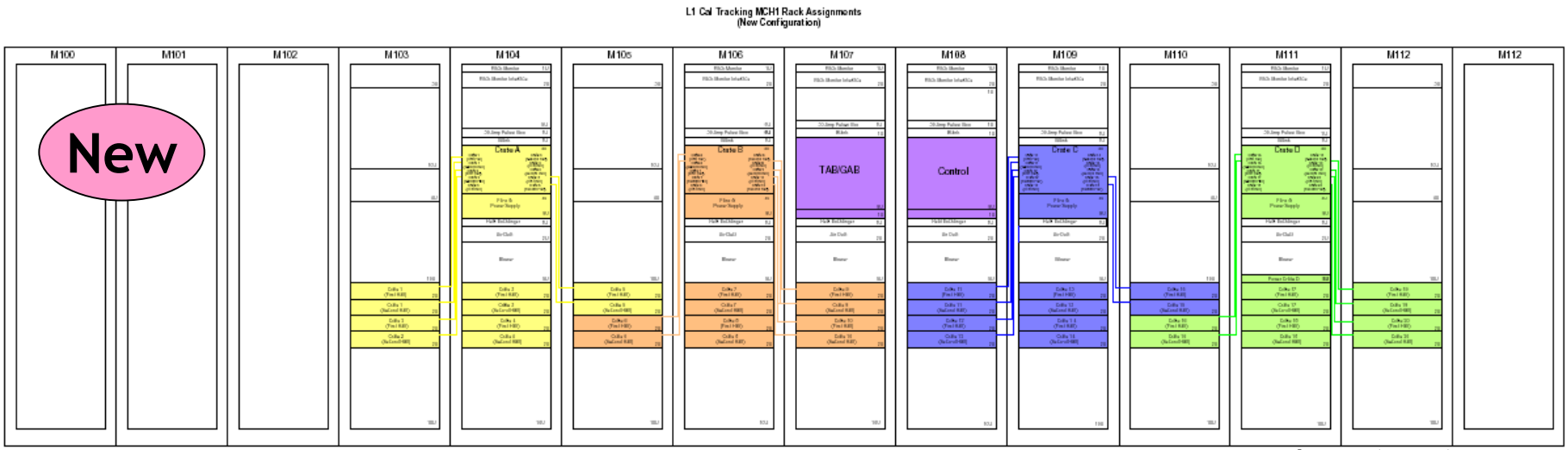


The next several slides show the details of the transition system.

MCH1 Configuration

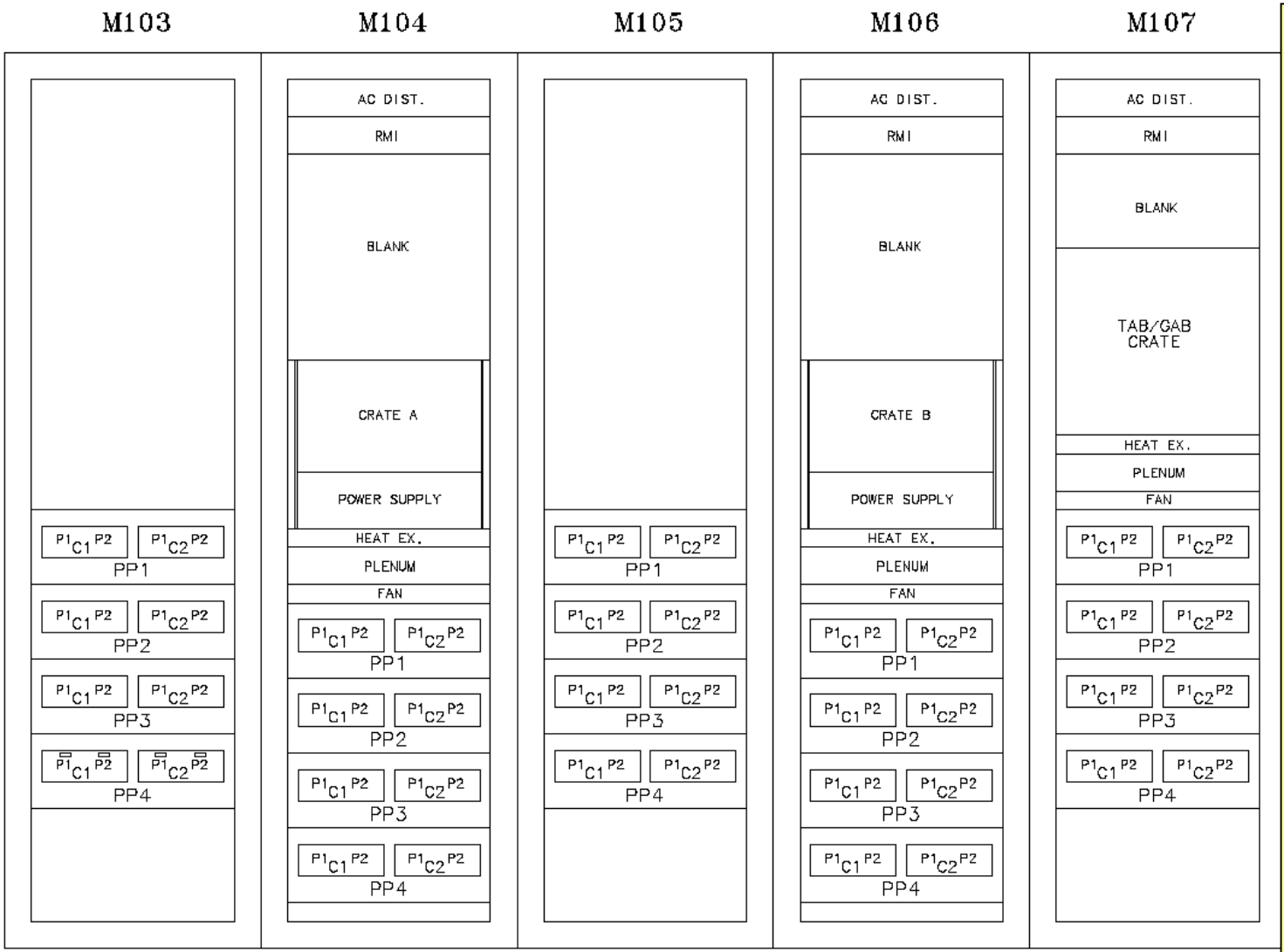


Color coding illustrates the old & new TT readout.



J. Fogelsong (2004)

Patch Panel

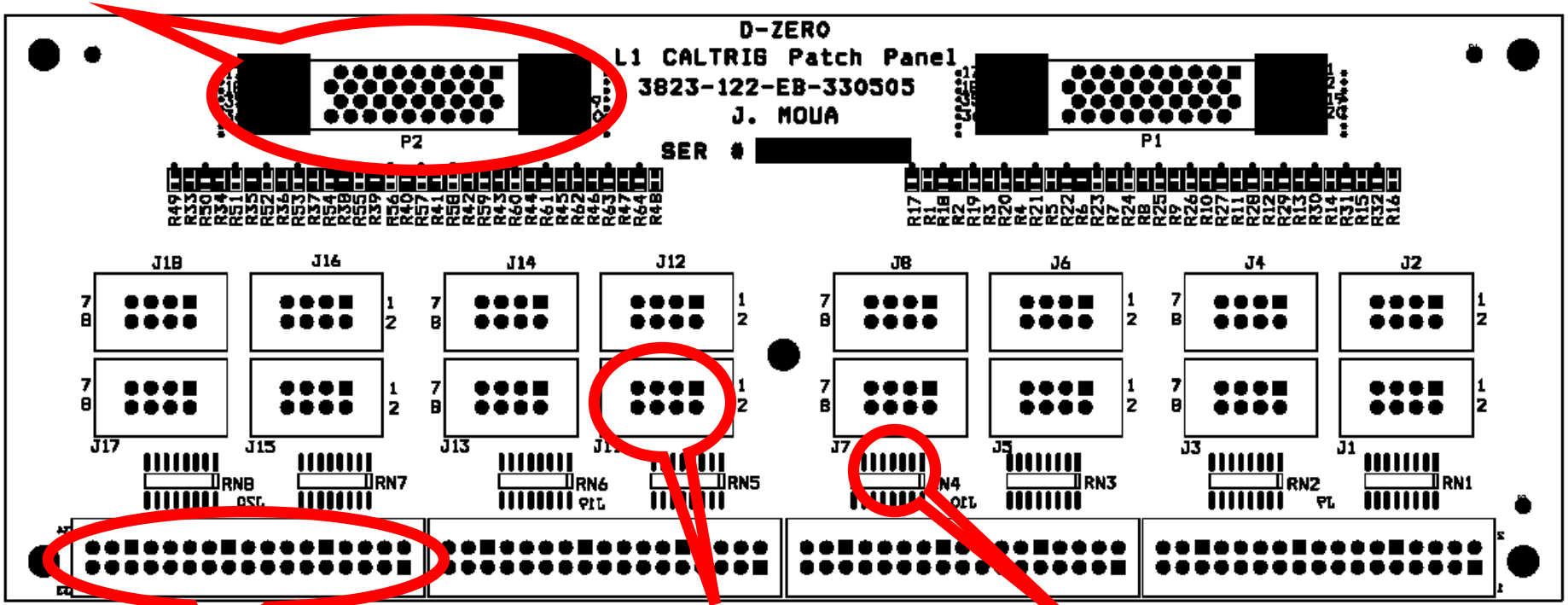


Four patch panels in the bottom half of each crate provide the mechanical means to route and support the BLS trigger cables and transition system. [See photo on first slide]

Need 40 Patch Panel Assemblies.

Patch Panel Card

Output to ADF (Pleated Foil Cables)



Monitor connectors

Input from BLS

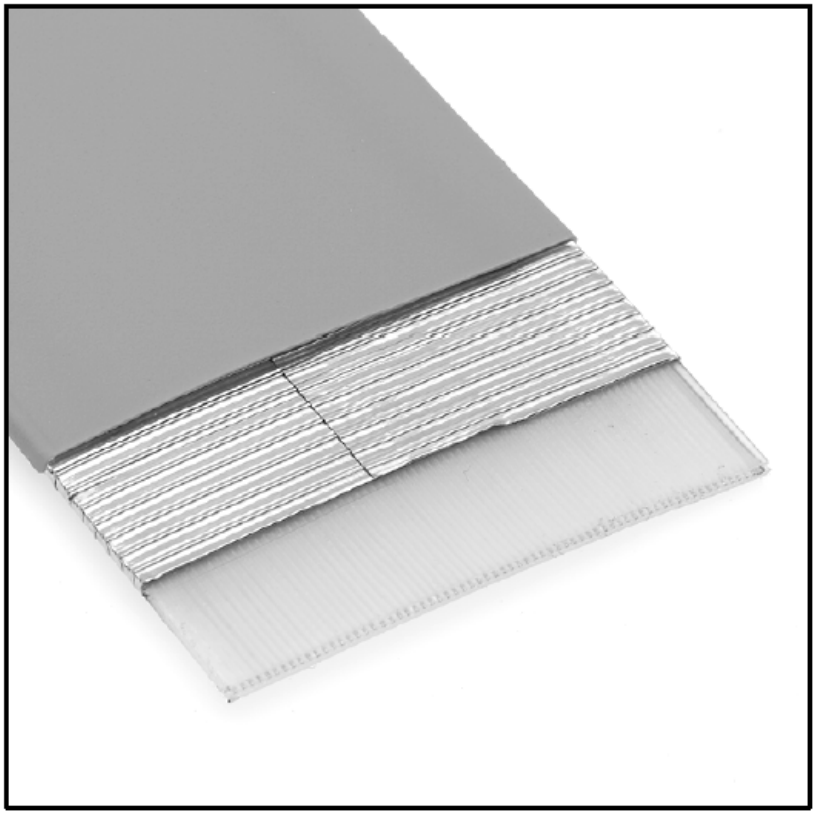
In line resistors

Two passive patch panel cards - stuffed printed circuit boards - mounted to each patch panel. Only the monitor connectors are visible from the front of the patch panel. Cables are connected from the back. Need 80.

Pleated Foil Cable

3M™ Pleated Foil Shielded Cable

.025″ 30 AWG Solid, TPE Primary, TPE Cover 90211 Series



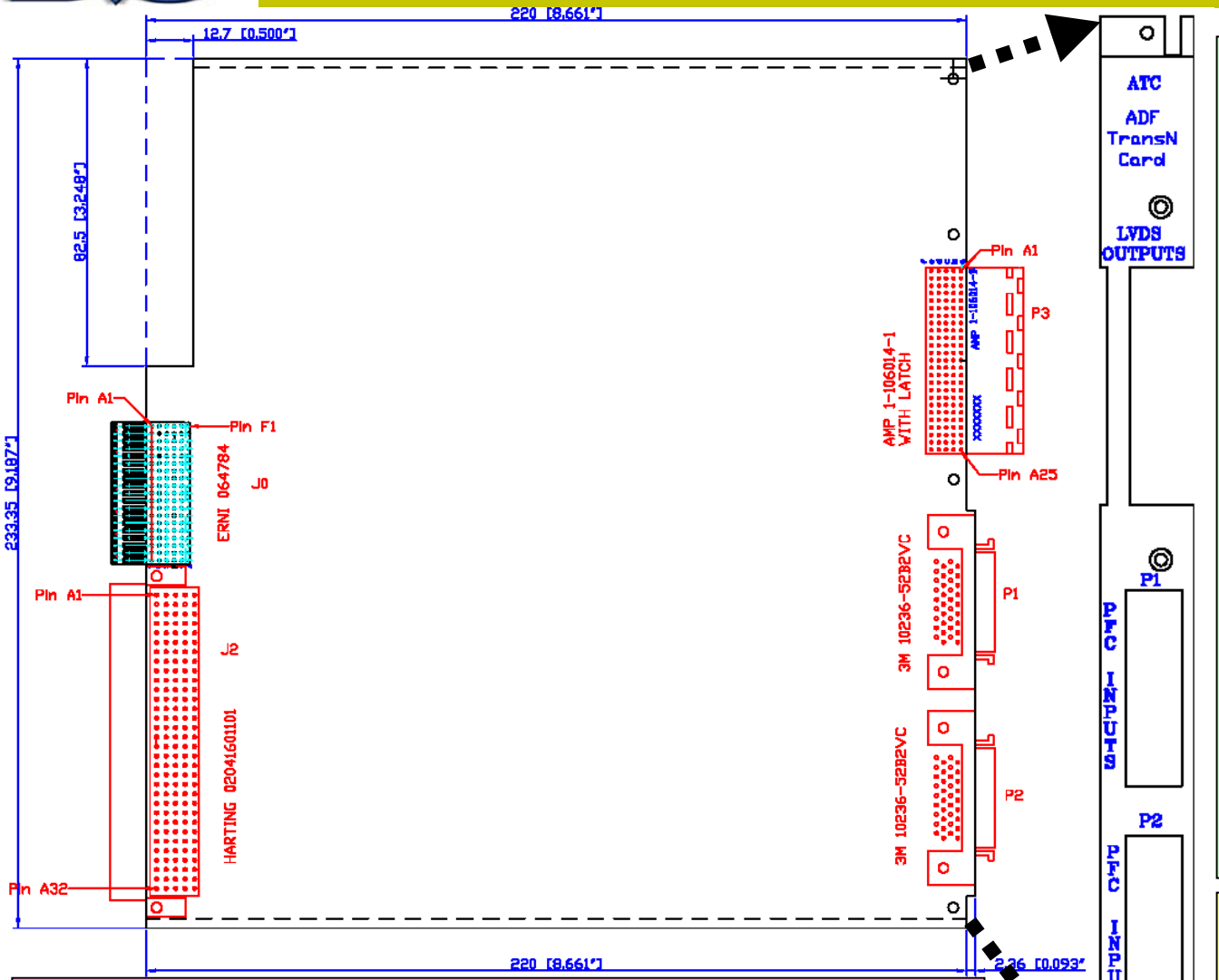
- Can be used with IDC mass termination connectors
- Can be used in applications requiring standard impedance of 75 ohms single ended
- Extremely low crosstalk, used in the all signal mode to quadruple signal density as compared to standard .050 inch flat ribbon cable
- Perfect for board-to-board applications within electronic equipment, TPE cover prevents pleated copper foil from accidental shorting
- Solid pleated copper foil provides flexibility and 35 db average shielding effectiveness

Date Modified: May 30, 2003

TS-0598-08
Sheet 1 of 2

Good impedance match to BLS trigger cables (D0 Note 4692). Two pleated foil cables carry TT signals from each patch panel card to the ADF Cards via the ADF backplane. Need 160.

ADF Transition Card & Faceplate



Two pleated foil cables carry analog TT signals from each patch panel card to the ADF Cards via the ADF backplane.
Three LVDS cables carry the the same digital ouput of the ADF Cards to three different TABs via the TAB backplane.
Need 80 of each.

Big kudos to Johnny Green, John Fogelsong, John Anderson, Dan Edmunds and Linda Bagby.

The need for an ATC came out of the Feb 2005 ADF-2 Review. Design, review, prototype, test, review and final production in less than six months.

Status of Transition System

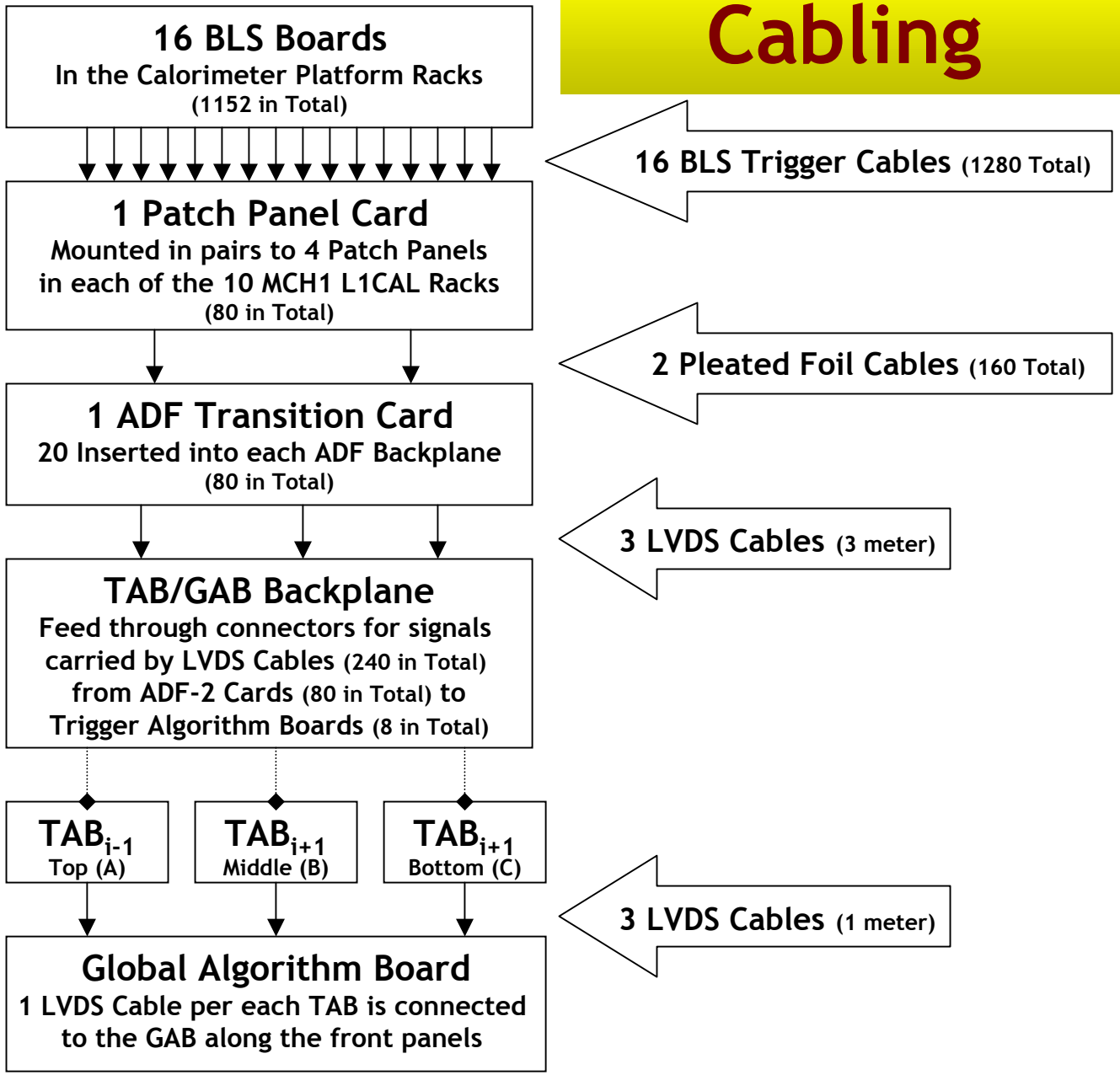
Item	Needed	In Hand	Tested or Built	Comments
Patch Panels	40	44	40	12 were assembled at the Sidewalk. The rest are in DAB3.
Patch Panel Cards	80	25	10	Final batch of 75 due Sep 6th. Test in conjuction with PFCs and ATCs.
Pleated Foil Cables	160	192	30	Waiting on other components for complete testing.
ADF Transition Cards	80	10	10	Design modification to address board warping. Batch of 12 due Sep 2nd. Final 80 one week later.
ATC Faceplates	80	10	10	Design modification to address tight machining. 100 new faceplates due Aug 31st.

See talk by Jorge Benitez on Transition System Testing.

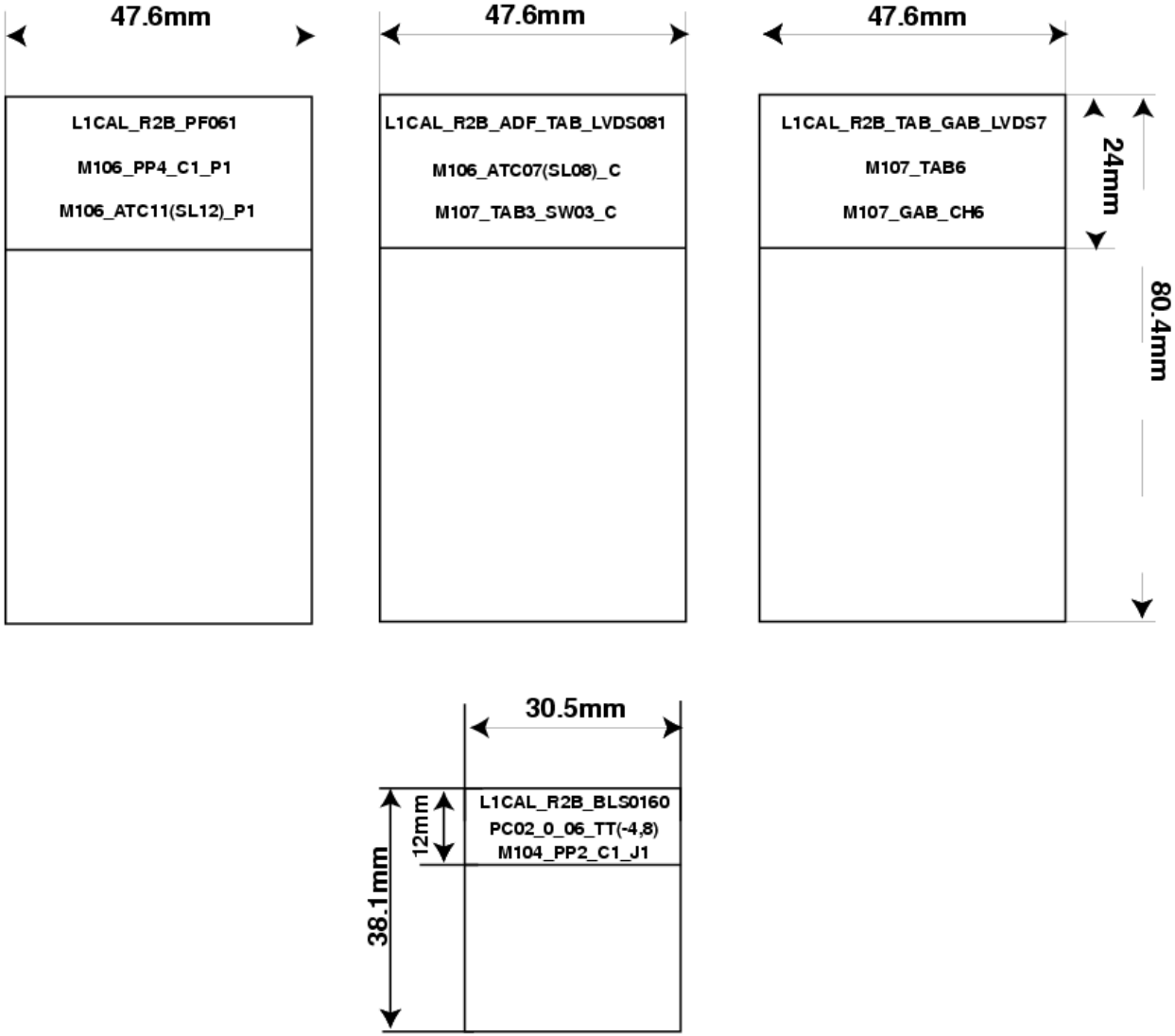
Cabling

Labeling scheme for all signal cables and associated components is described in D0 Note 4768 [See Slide 14].

The interrack wiring and strain relief systems have been or will be exercised with mechanical mock-ups on the sidewalk test stand, and then procedures documented in D0 Notes.



Cable Labeling



Each label has a unique, clear, concise and unambigious NAME, ORIGIN and DESTINATION.

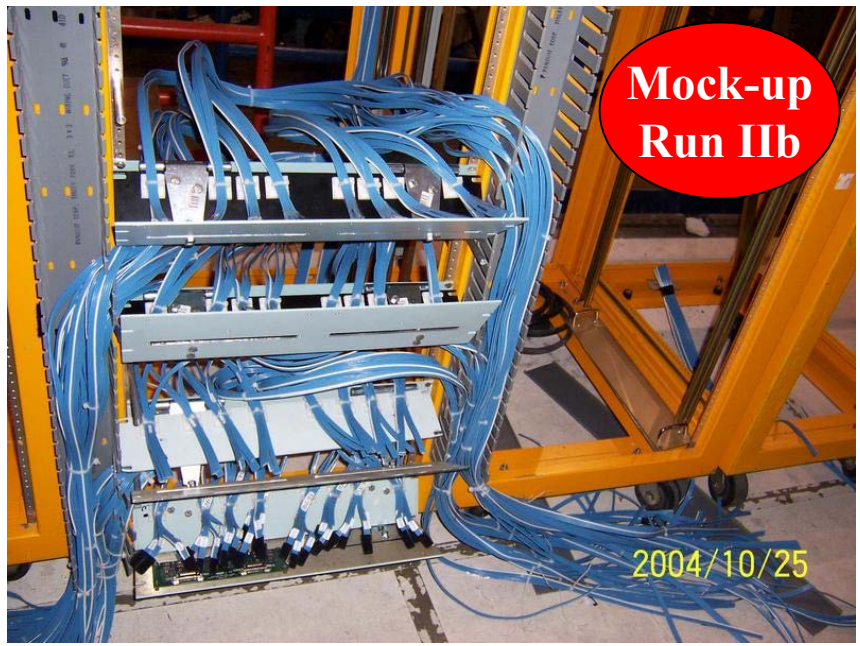
BLS trigger cables will be labeled as they are disconnected from the old electronics.

Pleated Foil and LVDS cables will be labeled after they have been tested on the sidewalk.

Cabling: BLS Trigger Cables

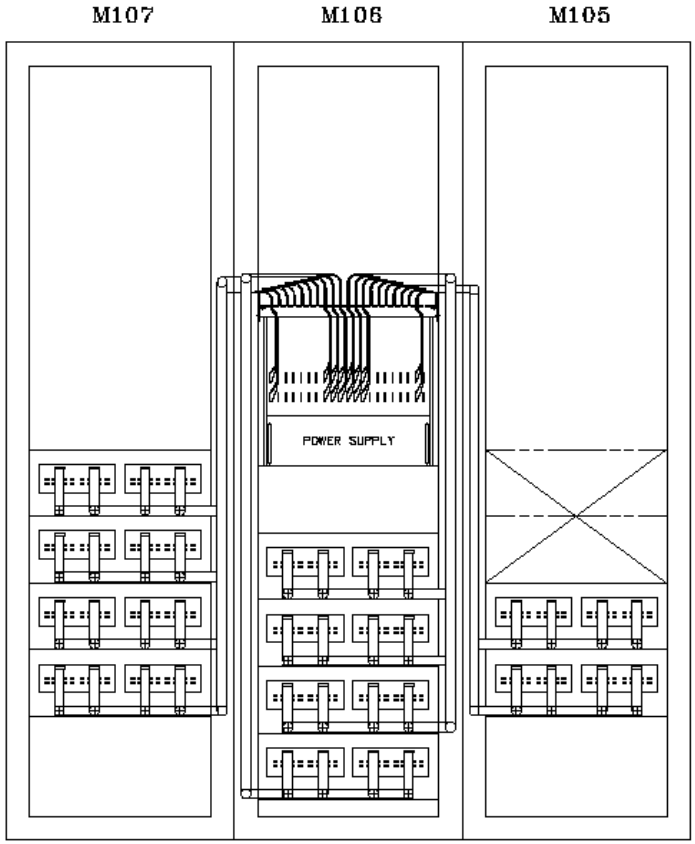
- A wise person advised me that most problems with cabling are mechanical not electrical.
  - Strain relief & volume flow
  - Connectorization
  - Labeling
- Take the time now to figure out how to go from Run IIa to Run IIb.
  - We will not have the luxury of time in November to figure it out on the fly.

- This is not easy!
  - Went through several iterations.
  - Verified channel map.
- Procedure documented in a D0 Note 4651.
- Note: It is possible that some fraction of BLS trigger cables will need to be reconnectorized after the installation of the transition system. See Dan Edmund's talk on Hardware Verification.

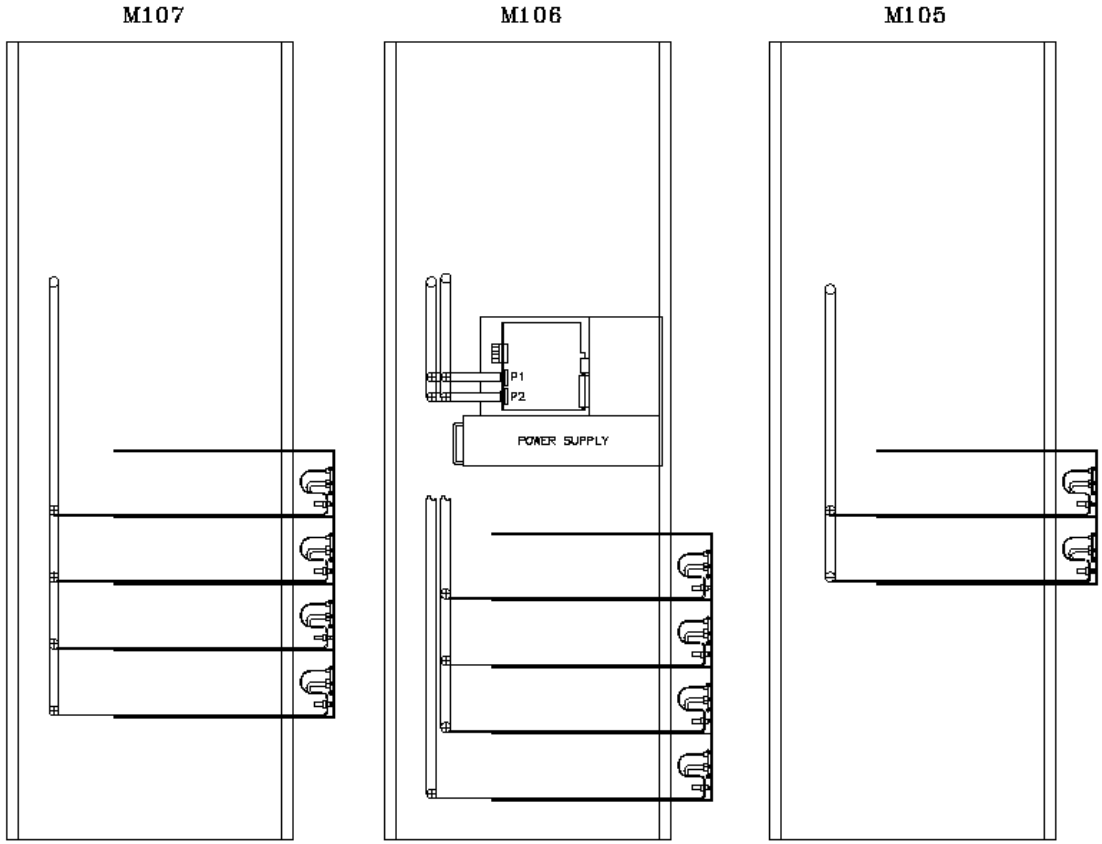


Cabling: Pleated Foil Cables

Rear View

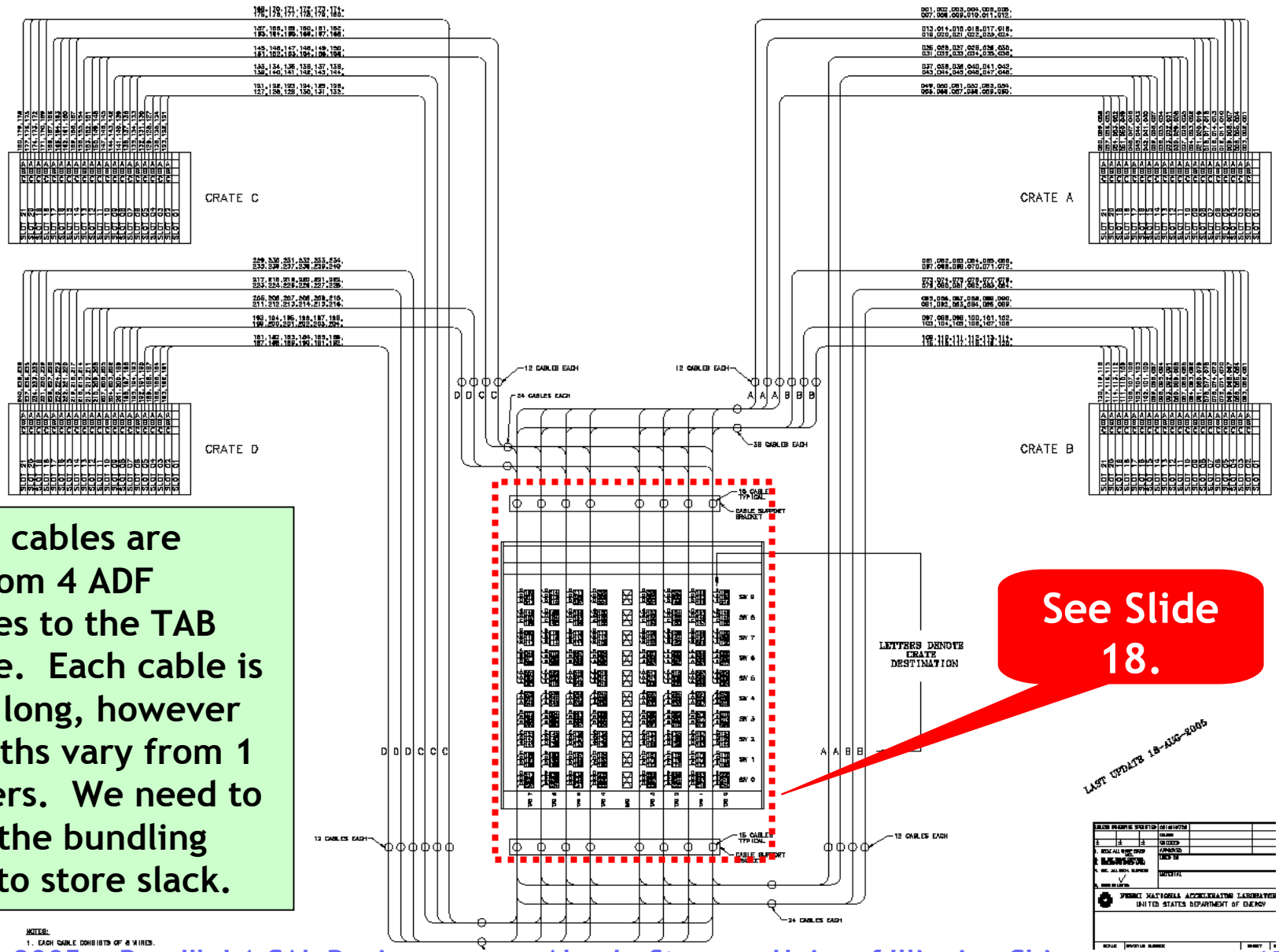


Side View



Front view is shown on Slide 8. Pleated foil cables are 10 feet in length. The cables drape from the top of the ADF backplane so as NOT to block access to the power supply beneath the ADF crate.

Cabling: ADF-to-TAB LVDS Cables

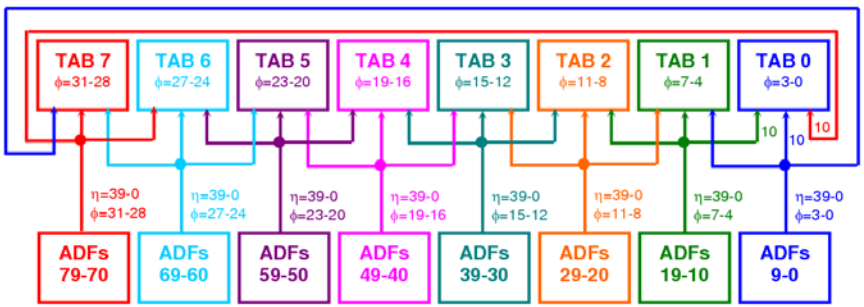


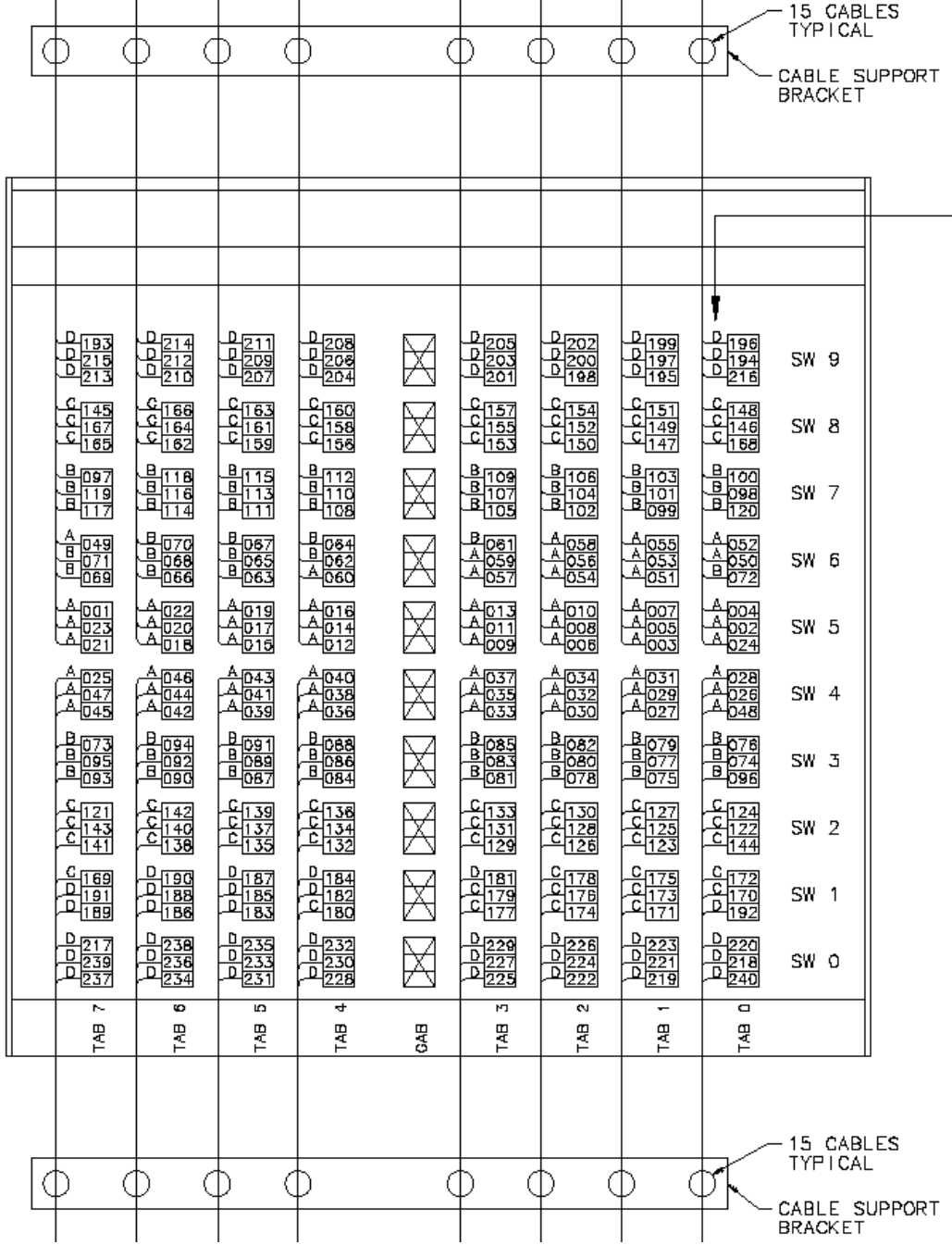
240 LVDS cables are routed from 4 ADF backplanes to the TAB backplane. Each cable is 5 meters long, however path lengths vary from 1 to 4 meters. We need to describe the bundling and how to store slack.

Cabling: TAB Backplane

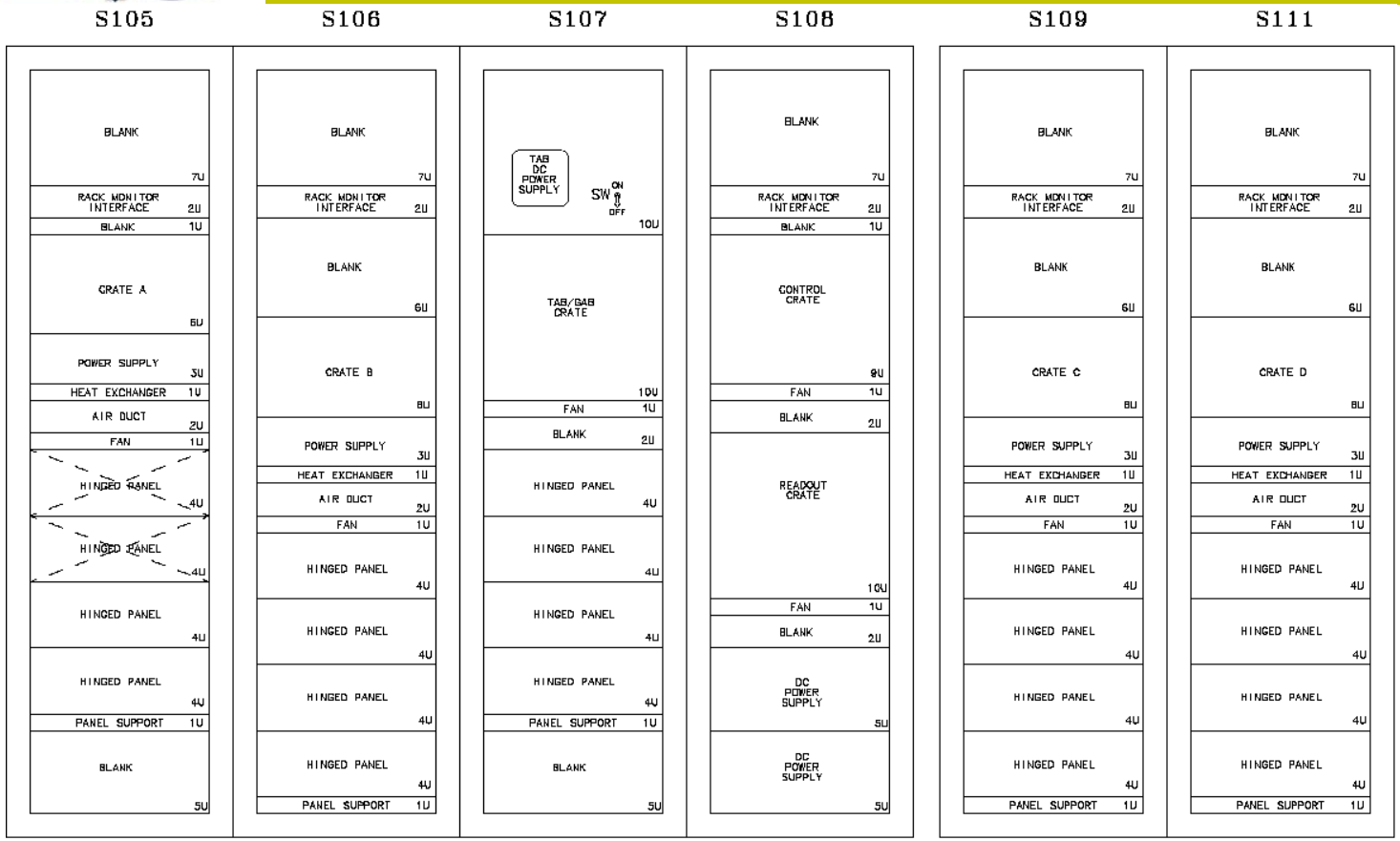
The cabling of the TAB backplane will be reminescent of telephone switchboard operator. Cables will have to cross to allow full access to the backplane, and to implement a strain relief system (top,bottom).

Each TAB (column) receives TT signals for a slice of phi for all of eta. In this diagram, A-B-C-D refer to the four ADF crates. Each SW input to the TABs gets a copy from three adjacent ADF boards.





Sidewalk Test Stand



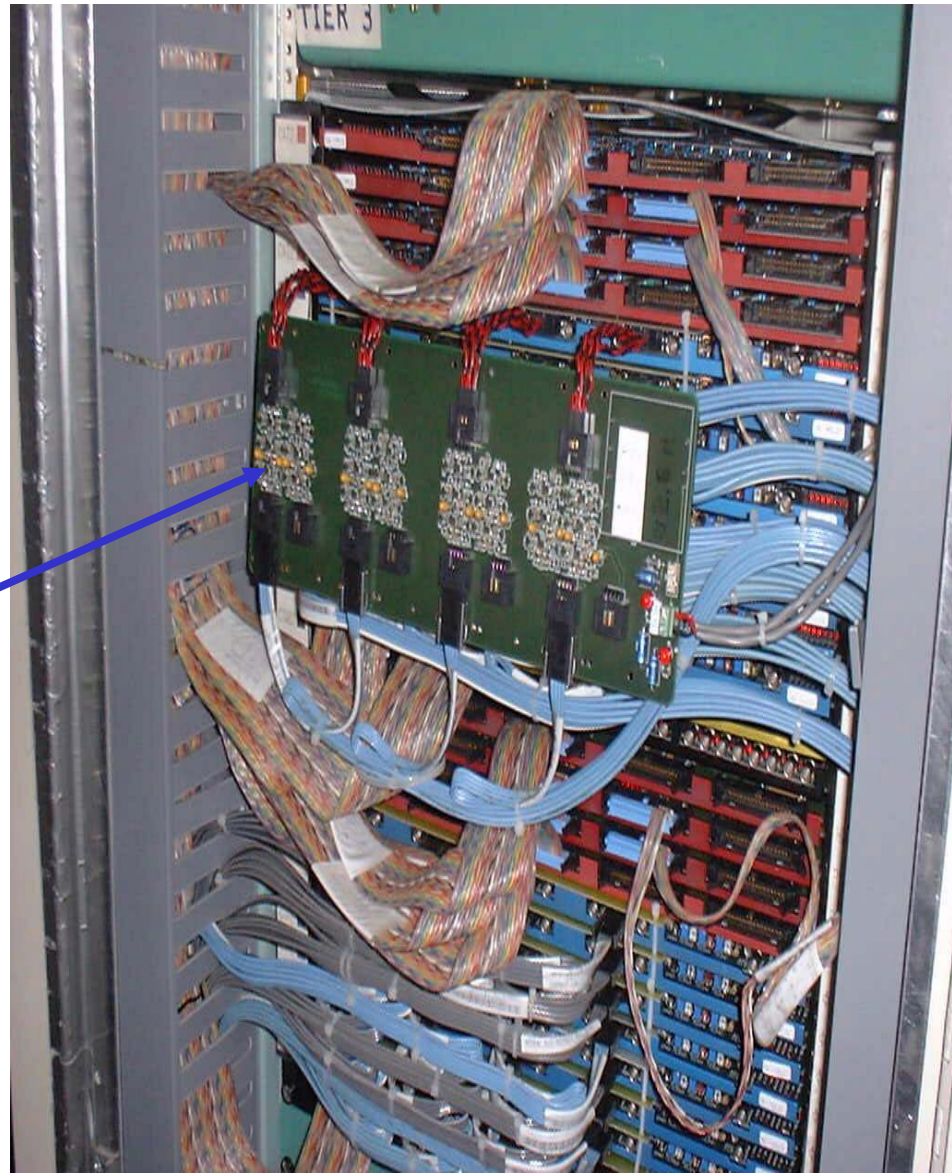
We intend to keep the sidewalk test stand up and running through and after the shutdown for quasi long term needs. The readout & comm crates stay on the sidewalk. We have spare TAB and ADF crates. Power distribution on sidewalk is different than MCH. We just need spare smoke detectors, RMIs, and cabling support systems for the sidewalk.

- Wooden platform adjacent to MCH1 near DAB pit isolated from building ground.
- Build the final Run IIb L1 CAL Trigger system with all active components (except BLS trigger cables).
  - Crates: 4 ADF, 1 TAB/GAB, 1 Readout, 1 Communication. [See Slide 20]
  - Online computer, L1 CAL Trigger control computer, BLS-to-ADF Transition System.
  - Safety system which allows for 24/7 operation. [See Linda Bagby's Operation Readiness talk]

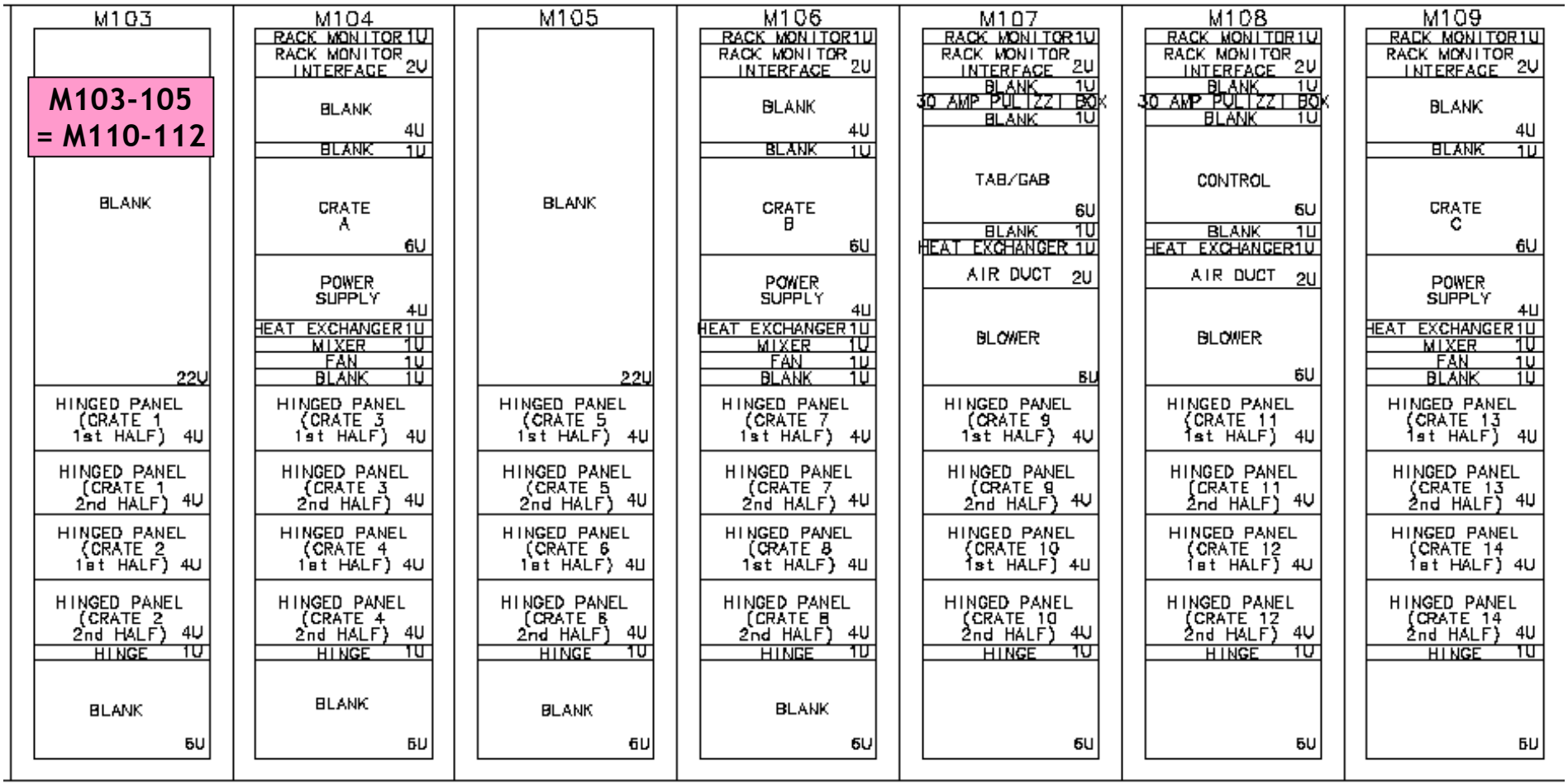
BLS Trigger Signal Splitter

- Access to real TT data using Splitter Boards
  - Designed and built by Saclay.
  - Active split of analog signals at CTFE input.
  - 4 TTs per board.
- Splitter data
  - No perturbation of Run IIa L1Cal signals.
  - Allows tests of digital filter algorithm with real data.
- BUT
  - At best, we will be able to install 4 splitters, for a total of 16 TTs (out of 1280).
  - Important to compare Run IIb TT with Run IIa TT and Precision Readout during a store & with the Calorimeter Preamp Pulser.

[See talks by Sabine Lammers and Peter Renkel]



Run IIb L1CAL MCH1 Rack Layout



Air & water cooling for ADF Crates. Air only for TAB/GAB & Communications Crates. Air, water and smoke interlocked with RMIs. 30 Amp Pulizzi for power distribution.

Status of Rack Infrastructure

	A	B	C	E	F	G	H	I	J	K	L	M	N
1	Item name	Total	Status	M103	M104	M105	M106	M107	M108	M109	M110	M111	M112
2													
3	ADF Crate	6	On Hand		1		1	1	1	1		1	
4	AC Distribution Box	6	On Hand		1		1	1	1	1		1	
5	Rack Monitor	6	Need To Order		1		1	1	1	1		1	
6	Rack Monitor Interface	6	On Hand		1		1	1	1	1		1	
7	1U Blank Panel	6	Need To Order		1		1	1	1	1		1	
8	5U Blank Panels 8-3/4"	6	Need To Order	1		1		1	1		1		1
9	Blank Panels - As Needed - Different Sizes												
10	Heat Exchanger	6	On Hand		1		1	1	1	1		1	
11	Air Plenums	6	Need To Be Built		1		1	1	1	1		1	
12	Fan Pack	6	On Hand		1		1	1	1	1		1	
13	Hinged Panels	40	On Hand	4	4	4	4	4	4	4	4	4	4
14	Right Angle Chassis Supports	52		4	6	4	6	6	6	6	4	6	4
15	RA Alum. 1/8" thick - 19-3/4" X 2" X2" Chassis Supports	24	Being Built		4		4	4	4	4		4	
16	Unistrut Rails 78-3/4" long	40		4	4	4	4	4	4	4	4	4	4
17	21" X 18-3/4" X 1/6" thick Alum. Cable Shelf	40	Need To Order	4	4	4	4	4	4	4	4	4	
18	Water Manifold Supply	6	Being Built		1		1	1	1	1		1	
19	Water Manifold Return	6	Being Built		1		1	1	1	1		1	
20	Check Valve	6											
21	Solenoid Valve	6											
22	Flow Meter-Proteus	6	Need Parts										
23	Hoses	36											
24	Quick Disconnects - Male	36	On Hand										
25	Quick Disconnects - Female	36	On Hand										
26	Elbow	36											
27	Elbow	12											
28	Hardware - 1/4-20 Hex Bolts & Washers												

AC distribution boxes plug directly into existing MCH1 power. The Tygon hoses are in good condition. Will install new heat exchangers, water manifolds, hoses, valves and flowmeters, and tie into existing water lines. Saftey monitoring - smoke, air flow, water flow, water drip - for six racks with active components. Cable support systems being built in-house.

Installation Overview

Item	Start Date	Duration	Comments
Shutdown	30 Oct 2005	14 wks	L0 (L1CAL) dominates installation (commissioning) schedule.
Noise Studies	31 Oct 2005	1 wk	Need Run IIa L1 CAL trigger. Decouple beam pipe. Etc.
Decable BLS Trigger Cables	7 Nov 2005	1 wk	Remove rack doors. Disconnect 1280 cables. Relabel. Store.
Remove Run IIa Electronics	14 Nov 2005	2 wk	Strip M102-113 racks to frames. Remove AC conduits.
Install Run IIb Services	28 Nov 2005	3 wk	Power, water, air, safety services. Install patch panels.
Reconnect BLS Trigger Cables	12 Dec 2005	1 wk	Redress. Strain relief.
Install Crates, TCC. Power.	14 Dec 2005	1 wk	4 ADF, 1 TAB, 1 L1CAL TCC. Reuse current Readout, Comm.
Pleated Foil, LVDS Cables	19 Dec 2005	1 wk	Route. Strain relief.
Other cabling	21 Dec 2005	1 wk	L2/L3 Optical. GAB-to-TFW. L1CalTrk Match. SCL.
System Checkout. ORC.	26 Dec 2005	1 wk	Install rack doors. ORC approval. Cabling, mapping.
Commissioning	>1 Jan 2006	6+ wks	

Installation Comments

- This schedule has gone through a few iterations between Rich Smith, Lyn Bagby and myself.
  - Last update was in late May 2005. The start date has obviously shifted.
  - Some items (shaded) can overlap if work is staggered over the full set of racks.
  - Duration for cabling based on experience from performing mock-ups.
  - I have tweaked a few dates and durations based on new experience and better understanding of the scale and scope - need to feed this information to Rich & the MS Project.
  - All durations assume one shift per day of either physicists or engineers
    - May have two crews for some tasks working in parallel
- Duration for stripping racks and installing services provided by John Anderson.
  - L1 CAL trigger upgrade will have to draw from the same pool of resources for mechanical and electrical support.
  - No engineer or technician is working 100% on L1 CAL.
  - We are assuming that overtime will not be an option.
  - A lot of advanced work done in building, ordering, preparing all rack infrastructure.
- The next order of business is to assign names to each task.
  - We already have a good idea of how much person power is needed [See Slide 25]

Installation Person Power

- Decable & Label BLS Cables
  - Two persons work as a team
  - 2 racks per day
  - Two teams can work in MCH1 at a time (physicists)
- Remove Run IIa
  - Remove boards, power supplies, heat exchangers, ribbon cables, airflow ductwork
    - Removal is faster as the components do not need to be recovered
  - Two persons work as a team
  - 1 rack per day
  - Two teams can work at opposite ends of MCH1 at a time (engineers)
    - But, may only have support for one team per day
    - May require welder to cut apart sub-crates
- Install Rack Infrastructure
  - Limited technician expertise for services
    - Estimate 1 rack per 2-3 days
    - 6 racks with services
  - Patch panels can be installed by physicists (<1 week)
- Reconnect BLS Cables
  - Services are done from rear of rack, BLS cables from front, so good possibility for overlap
  - Same plan as "Decabling"
- Crate Installation
  - Transport from Sidewalk to MCH1
  - Connect to power
  - Strong backs
  - Could take only a day
- Other Cabling
  - Pleated Foil & LVDS Cabling similar to BLS Cabling
  - Rest of system uses <100 cables which can be routed and connected entirely in < 1 day.

Important Note: Much of the installation takes place from mid-November through December. We need to factor into the schedule holiday vacations. Commissioning would begin after the New Year. Having an approved ORC before the New Year is very important.